

**KNOWLEDGE EXPECTATIONS FOR PEST CONTROL ADVISERS:
VERTEBRATE PEST MANAGEMENT**

I. LAWS AND REGULATIONS

1. List the laws and regulations pertinent to vertebrate pest management. [California Department of Fish and Game Code, Migratory Bird Treaty Act, Endangered Species Act, California Department of Food and Agriculture Administrative Code, County Interim Measures Bulletins, local ordinances]
2. Describe how different laws and regulations may pertain to the control or management of specific vertebrate pests and how they influence:
 - a. which species can be managed;
 - b. the techniques or methods used;
 - c. the considerations and safeguards needed to protect nontarget species.
3. List the agency or agencies that enforce laws and regulations pertinent to vertebrate pest management. [US EPA, US Fish and Wildlife Service, California Department of Fish and Game, California Department of Food and Agriculture, California Department of Pesticide Regulation, County Agricultural Commissioner, California Department of Public Health, State Highway Patrol]
4. Describe how more than one law or regulation may apply to the management of the following pests:
 - a. ground squirrels;
 - b. tree squirrels;
 - c. crows.
5. Recognize that information on laws and regulations pertaining to vertebrate pest management can be found in the study guide. [California Vertebrate Pest Control Handbook—<http://www.vpcrac.org/about/vertebrate-pest-handbook/>]
6. Understand to check first with the county agricultural commissioner or district USDA Wildlife Services for potential local, site-specific information regarding vertebrate pest management.
7. Recognize that pest management recommendations that violate the Endangered Species Act may result in criminal charges.

II. VERTEBRATE PEST ID

1. Be familiar with the following vertebrates and understand their general biology, ecology, and management tactics.
 - a. Birds:
 - i. blackbirds
 - ii. burrowing owls
 - iii. cliff swallows
 - iv. crowned sparrows
 - v. crows
 - vi. geese
 - vii. gold finches
 - viii. gulls
 - ix. herons
 - x. horned larks
 - xi. house finches (linnets)
 - xii. house sparrows

- xiii. kingfishers
- xiv. magpies
- xv. pigeons
- xvi. scrub jays
- xvii. starlings
- xviii. terns
- xix. wild turkey [California Department of Fish and Game Turkey Hunting Guide – <http://www.dfg.ca.gov/Hunting/>]

b. Mammals:

- i. bats
- ii. bears
- iii. beavers
- iv. chipmunks
- v. coyotes
- vi. deer
- vii. feral dogs
- viii. marmots
- ix. moles
- x. mountain lions
- xi. opossums
- xii. pocket gophers
- xiii. porcupines
- xiv. rabbits, hare
- xv. raccoons
- xvi. skunks
- xvii. wild pigs

c. Squirrels:

- i. ground squirrels (Belding’s, California, golden-mantled, and Oregon ground squirrels)
- ii. tree squirrels (Douglas, eastern fox, eastern gray, and western gray squirrels)

d. Rats and Mice:

- i. cotton rats
- ii. muskrats
- iii. Norway rats
- iv. roof rats
- v. wood rats
- vi. deer mice
- vii. house mice
- viii. meadow voles

e. Threatened and Endangered species: [Endangered Species Project Applicator Training Materials Field Identification Cards–www.cdpr.ca.gov; US EPA Endangered Species Protection Program Fact Sheets–<http://www.epa.gov>]

- i. blunt-nosed leopard lizards
- ii. Fresno kangaroo rats
- iii. giant kangaroo rats
- iv. Morro Bay kangaroo rats
- v. salt marsh harvest mice
- vi. San Joaquin kit fox
- vii. Stephen’s kangaroo rats
- viii. Tipton kangaroo rats
- ix. California tiger salamander

2. Define vertebrate pest.
3. Describe characteristics that make an animal a pest. [high reproductive rate, high density-congregating behavior, propensity for feeding on crop, overabundance, value of crop being damaged, nuisance behaviors, vectors or reservoirs for disease]

A. Identification

1. Identify the major mammal pests in California agricultural crops. [eastern fox squirrels, deer, ground squirrels, jackrabbits, meadow voles, Norway rats, pocket gophers, rats, wild pigs]
2. Identify the major bird pests in California agricultural crops. [blackbirds, crows, crowned sparrows, gold finches, house sparrows, horned larks, house finches, jays, magpies, starlings]
3. Describe ways in which the identity of a vertebrate pest might be confirmed. [direct observations, use of remote-triggered cameras; location and patterns of damage; look for further signs such as tracks, droppings or hair; time of day that damage occurs; trapping]
4. List resources to assist in vertebrate pest identification. [Vertebrate Pest Control Handbook, UC IPM Web site, Peterson bird ID book, Wildlife Pest Control Around Gardens and Homes (UC Publication 21385), Animal Tracks by O. J. Murie, Mammals of the Pacific States]

B. Pests and Crop or Environment Associations

1. List the vertebrate pests most commonly associated with the following agricultural crops:
 - a. alfalfa [California and Belding's ground squirrels, jackrabbits, meadow voles, pocket gophers]
 - b. citrus [ground squirrels, meadow voles, roof rats]
 - c. deciduous fruit trees [ground squirrels, house finches, meadow voles, pocket gophers, starlings]
 - d. forage crops [ground squirrels, meadow voles, pigs, pocket gophers]
 - e. grapes [meadow voles, pocket gophers, starlings]
 - f. lettuce [horned larks]
 - g. nut trees [crows, ground squirrels, jays, magpies, pocket gophers, tree squirrels]
 - h. rice [blackbirds, muskrats, Norway rats]
 - i. strawberries [gold finches, ground squirrels, meadow voles]
 - j. sugarbeets [ground squirrels, meadow voles]
 - k. tomatoes [meadow voles]
2. Know the vertebrate pests that
 - a. commonly cause problems in forestry. [deer, mountain beaver, pocket gophers, porcupines, rabbits, tree squirrels]
 - b. cause problems at cattle feedlots, dairies, and poultry and pork producing facilities. [blackbirds, house mice, house sparrows, Norway rats, roof rats, pigeons, starlings]
 - c. are considered of significance to public health. [bats, deer mice, ground squirrels, raccoons, rats [Norway and roof], skunks]
 - d. are major pests of stored commodities and food processing facilities. [house mice, house sparrows, pigeons, rats [Norway and roof]]
3. Know the predators responsible for major livestock losses in California. [coyotes, dogs, mountain lions]

4. In suburban and urban environments, know the
 - a. mammals that are often considered nuisance pests. [bats, meadow voles, moles, opossums, pocket gophers, raccoons, skunks, tree squirrels]
 - b. birds that are often considered nuisance pests. [crows, geese, pigeons, starlings, swallows]

C. Distribution

1. Recognize that the following vertebrate pests are of limited distribution or occupy specific habitats:
 - a. Belding's ground squirrels;
 - b. cotton rats;
 - c. marmots;
 - d. mountain beavers.

D. Nature of Pest Damage

1. Recognize signs and symptoms used to identify damage caused by the following vertebrate pests:

<ol style="list-style-type: none"> a. cotton rat; b. crows; c. deer; d. deer mice; e. ground squirrels; f. horned larks; g. house finches; h. house mouse; i. jackrabbits; j. marmot; k. meadow voles; 	<ol style="list-style-type: none"> l. moles; m. muskrats; n. Norway rat; o. pocket gophers; p. raccoons; q. roof rat; r. skunks; s. tree squirrels; t. wild pigs; u. wood rat.
---	--
2. List the vertebrate pests associated with the following damage symptoms:
 - a. girdling of trees—above ground
 - b. girdling of trees—below ground
 - c. vegetable seedling damage
 - d. disbudding of deciduous fruit trees
 - e. damage to ripening fruit
 - f. damage to drip irrigation systems
3. Differentiate between the types of damage caused by the following vertebrate pests:
 - a. mole, pocket gopher, and meadow vole in turf;
 - b. pocket gophers and ground squirrels in field crops;
 - c. carnivore and rodent damage to drip irrigation.
4. Recognize the bird pest and the damage or problem caused in:
 - a. aquaculture facilities – gulls, herons, kingfishers, terns
 - b. buildings and other structures – house sparrows, pigeons, swallows nesting in or on structures
5. List the vertebrate pests that are associated with damage to levees and earthen dams. [beaver, ground squirrel, muskrat, pocket gopher]

E. Native or Introduced Pests

1. Recognize that the following vertebrate pests are not native to California:
 - a. domestic pigeons;
 - b. eastern fox squirrels
 - c. house mice;
 - d. house sparrows;
 - e. opossums;
 - f. rats (Norway and roof);
 - g. starlings;
 - h. turkeys;
 - i. wild pigs.

III. VERTEBRATE PEST BIOLOGY AND ECOLOGY

A. Population Dynamics

1. Describe how vertebrate pest populations may be influenced by:
 - a. litter size;
 - b. number of litters per year;
 - c. cyclic population trends;
 - d. habitat requirements;
 - e. average lifespan and relative survival rates.
2. Describe how vertebrate pest populations may be limited by the following external factors:
 - a. food source and abundance (habitat fragmentation);
 - b. shelter;
 - c. water;
 - d. predators/diseases.

B. Behavioral Characteristics

1. Describe how the following may influence management:
 - a. hibernation/estivation;
 - b. dietary changes;
 - c. bait shyness;
 - d. neophobia;
 - e. cover or shelter;
 - f. soil moisture and composition;
 - g. activity patterns (diurnal/seasonal).

C. Habitats

1. Describe the habitats of the following pests:
 - a. crows;
 - b. deer;
 - c. ground squirrels;
 - d. horned larks
 - e. house finches (linnets);
 - f. meadow voles;
 - g. moles;
 - h. pocket gophers;
 - i. rabbits and hares;
 - j. rats;
 - k. tree squirrels.
2. Describe the visible differences between the burrows and mounds of the following vertebrate pests:
 - a. ground squirrels;
 - b. meadow voles;

- c. moles;
 - d. pocket gophers;
 - e. kangaroo rats.
3. Describe how to distinguish between an active and inactive burrow.
 4. Describe how to determine if a ground squirrel burrow is being used by a target pest species or by one of the following nontarget species:
 - a. burrowing owl [white wash];
 - b. kit fox [key hole shape]

D. Disease Carriers

1. Identify the pest(s) most often associated with the following diseases:
 - a. plague [ground squirrels and chipmunks];
 - b. histoplasmosis [pigeons];
 - c. leptospirosis [rats];
 - d. hantavirus [deer mouse];
 - e. lyme disease [western gray tree squirrel];
 - f. rabies [skunks and bats];
 - g. salmonellosis [rats and mice].
2. Identify the most common methods of human exposure for each of the following diseases:
 - a. plague;
 - b. histoplasmosis;
 - c. tularemia;
 - d. salmonellosis;
 - e. hantavirus;
 - f. lyme disease;
 - g. rabies.
3. Describe the importance of ectoparasite control:
 - a. when carrying out ground squirrel and chipmunk management in areas of high plague potential;
 - b. in association with commensal rodent management or bat exclusion.

IV. VERTEBRATE PEST MANAGEMENT

A. Assessing the Problem and Determining Strategies

1. Describe the steps taken to assess a vertebrate pest problem. [ID species, location of damage, survey extent, severity and type of damage, trapping]
2. List the factors that must be considered in determining whether a management action should be taken. [pest population, management costs, efficacy of the management strategy, time of year, cost of damage and risk of future damage, seasonal stage of the crop, environmental concerns, human health concerns]
3. Describe how the following short- and long-term solutions may differ and when each may be the best choice:
 - a. shooting deer vs. deer proof fence;
 - b. acute poison vs. habitat management for meadow voles.
4. Describe several key management options available for the following vertebrate pests in nut crops:

- a. ground squirrels;
 - b. crows;
 - c. meadow voles;
 - d. jays.
5. Describe how a combination of methods in an integrated pest management program would be used over time to manage:
- a. ground squirrels;
 - b. meadow voles;
 - c. pocket gophers;
 - d. roof rats.

B. Environmental Management and Habitat Manipulation, Including Crop Cultural Practices

1. Describe how the following habitat modifications in urban situations can impact vertebrate pests:
 - a. food removal;
 - b. cleaning up rotten fruit;
 - c. removing bird feeders;
 - d. removing wood piles;
 - e. eliminating cover/ivy;
 - f. eliminating water sources;
 - g. eliminating bird nesting sites.
2. Describe the impact of the following cultural practices on vertebrate pests in crop situations:
 - a. irrigation methods;
 - b. crop type and variety;
 - c. field border sanitation;
 - d. brush and pruning pile removal;
 - e. cover crops;
 - f. tree and vine row herbicide and mowing treatments;
 - g. burrow destruction;
 - h. crop rotation;
 - i. cultivation.

C. Exclusion

1. Describe how the following might be used to prevent damage or pest access:
 - a. non-electric fencing/exclusion fencing [deer, rabbits, wild pigs];
 - b. electric fencing [bears, coyotes, deer, raccoons];
 - c. tree guards [deer, deer mice, rabbits, rats, voles];
 - d. netting [birds];
 - e. wire mesh planting baskets [gophers].
2. Recognize the importance of removing animals [and their progeny] from buildings before installing exclusion materials. [bats, raccoons, skunks, tree squirrels]

D. Frightening Methods

1. Describe how each of the following bird frightening devices or methods might best be used, alone or in combination, to temporarily protect orchard or vine crops from damage:
 - a. propane exploders;
 - b. reflective tapes;
 - c. eye balloons;
 - d. human effigies;
 - e. distress calls;
 - f. cracker shells and bird bombs;
 - g. electronic noisemakers.
2. Explain how habituation may influence the effectiveness of many frightening methods. Know the methods to reduce habituation and/or increase the efficacy of frightening devices.

E. Trapping

1. List pests for which the following traps would be used:
 - a. modified Australian crow trap [house finch, starlings];
 - b. Macabee, Cinch, and Gophinator [gophers];
 - c. Out O' Sight [moles];
 - d. cage-type live-traps [ground squirrels, rabbits, raccoons, opossums, skunks];
 - e. modified California-type box trap [eastern fox squirrel, ground squirrels];
 - f. tube trap [eastern fox squirrels, ground squirrels];
 - g. Conibear-type trap [ground squirrels];
 - h. harpoon trap [moles];
 - i. glue boards [house mouse]
 - j. snap traps [deer and house mice, meadow voles, and rats].
2. Explain how CO₂ can be used to euthanize live, trapped animals.
3. Recognize that translocation of vertebrate pests, such as ground squirrels, rabbits, pocket gophers, and skunks is illegal according to California law.

F. Shooting and Hunting

1. List vertebrate pests that may be controlled by shooting or hunting.
2. Recognize that local fire arm restrictions may apply when using shooting or hunting to manage vertebrate pests.
3. Understand restrictions for use of lead bullets within the California condor range.
[<http://www.dfg.ca.gov/wildlife/hunting/condor/>]

G. Mechanical Control

1. Know how burrow exploder devices work. [a burrow exploder inserts a flammable gas into a burrow and ignites it, creating an explosion that kills burrowing animals]

H. Chemical Repellents

1. Describe how chemical repellents deter vertebrate pests. [tactile/sticky compounds make area unpleasant, by odor, by taste, combination of taste and odor]
2. List examples of chemical repellents that are used against the following pests:
 - a. blackbirds;

- b. deer;
 - c. geese;
 - d. pigeons;
 - e. starlings.
3. Explain why the usefulness and effectiveness of sticky type repellents may be limited. [time consuming to apply, adversely affected by temperature, dust readily adheres to them; must be reapplied periodically, difficult to remove]
 4. Explain why chemical repellents are not an effective long-term solution for the management of deer.

I. Chemical Lethal Control

1. List the active ingredients registered as rodenticides, including burrow fumigants. Define acute toxicant, fumigant, first generation anticoagulant and second generation anticoagulant. Know examples of the active ingredient for each type. [acute toxicants—strychnine, zinc phosphide, bromethalin, cholecalciferol; burrow fumigants—aluminum phosphide; first generation anticoagulants—chlorophacinone, diphacinone, warfarin; second generation anticoagulants—brodifacoum, difethialone, bromadiolone, difenacoum]
2. Describe the general characteristics, including the capabilities and limitations, of commonly used baits and burrow fumigants.
3. Understand primary and secondary poisoning. Know which type of rodenticide has the greatest potential for secondary poisoning. [Primary poisoning is the toxic effects of a substance on an organism that directly consumes the poison, whether it be the target organism or not. Secondary poisoning occurs when an organism comes in contact with and is poisoned by another organism that was poisoned; for example, a dog eats a poisoned rodent and gets sick. First and second generation anticoagulants have the greatest potential for secondary poisoning.]
4. Identify how the following items relate to specific rodenticides:
 - a. mode of action of anticoagulants;
 - b. effectiveness for various target pests;
 - c. potential for producing primary poisoning in nontarget species;
 - d. potential for secondary poisoning in nontarget species;
 - e. which have effective antidotes;
 - f. potential for producing 'bait shyness';
 - g. restricted or nonrestricted use category.

▪ Baits

1. Describe how the following can influence effectiveness of a vertebrate pest management program using baits:
 - a. pre-baiting;
 - b. testing bait acceptance;
 - c. timing (seasonal) of baiting;
 - d. frequency of baiting;
 - e. application method;
 - f. bait shyness.

2. Name the rodenticides that are registered for baiting field rodents.
[chlorophacinone, diphacinone, strychnine, zinc phosphide]
3. Describe how the following procedures can help avoid primary or secondary poisoning of nontarget species:
 - a. the use of bait stations;
 - b. removal of rodent carcasses;
 - c. using the rodenticide that causes the least harm to nontarget species;
 - d. following label specifications;
 - e. use of traps instead of baits;
 - f. bait storage out of the reach of domestic animals.
4. Describe how the following conditions affect bait efficacy:
 - a. bad odors;
 - b. moldy;
 - c. insect infested;
 - d. age.
5. Describe the different methods used for applying rodent baits. [broadcast, spot bait, bait station]
6. Identify situations that favor the use of the following rodent bait application methods:
 - a. bait boxes;
 - b. spot baiting;
 - c. mechanical broadcasting.
7. List vertebrate pests where the use of paraffin baits might be utilized. [rats, deer and house mice, pocket gophers, muskrats]
8. List the advantages of paraffin baits in vertebrate pest control. [easily handled and stored, weather resistant, resistant to molds and insects, unattractive to birds]
9. List the reasons for using colored baits. [required by law; helps identify treated vs. nontreated, helps identify different active ingredient concentrations, birds are repelled by colors and rodents are color blind]
- **Fumigants**
 1. Describe the appropriate application methods for the use of burrow fumigants.
 2. Describe how the following factors may influence burrow fumigant effectiveness:
 - a. soil moisture;
 - b. soil texture;
 - c. time of year;
 - d. temperature.

J. Biological Control

1. Generally understand predator/vertebrate prey population regulation. In particular, for predator/prey relationships, be able to explain why the number of prey often determines the number of predators and not vice versa.

K. Environmental Considerations

1. Know that field assessments are made to determine if and which nontarget species including threatened and endangered species may be at risk.
2. Describe how the following are used to assist in safeguarding nontarget species:

- a. fumigation of active holes only;
 - b. use of color-dyed baits;
 - c. bait boxes with three-inch openings [exclude kit fox];
 - d. elevated bait stations [exclude kangaroo rats];
 - e. use of live traps;
 - f. referencing county bulletins.
3. Describe how to find out which threatened and endangered species in the area of treatment might be at risk from rodent management. [DPR web site—examples of threatened/endangered animals: blunt-nosed leopard lizard; California red-legged frog; Fresno kangaroo rat; giant kangaroo rat; Morro Bay kangaroo rat; riparian brush rabbit; riparian wood rat; salt marsh harvest mouse; San Bernardino kangaroo rat; San Joaquin kit fox; Stephen's kangaroo rat; California tiger salamander; Tipton kangaroo rat]

L. Economic Evaluations and Considerations

1. List the economic factors to be considered in vertebrate pest management programs.
2. Describe how the cost can be compared with the benefit of vertebrate pest management.
3. Know that benefits may have to be assessed for several years beyond the year of management action.